# In-Flight Validation of Remotely Sensed Thermal Infrared Data using an Automated Validation Site – Lake Tahoe, CA

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## Abstract

In December 1999 NASA's first Earth Observation System platform (Terra) was launched into earth orbit. Five instruments are mounted on the platform that is being used to produce a set of standard data products for the scientific community. The standard products include several products derived from the data acquired in the thermal infrared channels such as radiance at sensor, radiance at surface, surface temperature and surface emissivity. These products will be used for a wide variety of applications and it is essential that these products are validated to ensure the instruments and the standard product algorithms are functioning correctly.

In-flight validation of thermal infrared data is well established. Currently, this involves mounting validation campaigns in which researchers from several institutions make various ground and atmospheric measurements. The data from these campaigns are then used to propagate the surface radiance through the atmosphere to derive a radiance that can be compared directly with the radiance derived by the satellite- or aircraft- mounted sensor. In addition, the satellite- or aircraft derived sensor radiance can be compensated for atmospheric effects, using the data acquired in the campaign, to derive a surface radiance, temperature or emissivity that can be compared with the corresponding parameter measured on the surface. The primary difficulty with this validation approach is it results in a very limited number of seasonally restricted validation datasets. This difficulty arises for three reasons. First it is extremely difficult to mount large campaigns on a regular basis throughout the year. Second the orbit configuration of the instruments limits the number of times an area can be imaged in a given time interval. Third the season with the greatest chance of resulting in cloud-free data over the validation site must be selected in order to maximize resource use. In order to address these limitations we have instrumented a small number of sites to automatically obtain a basic set of validation data, under a range of atmospheres, throughout the year.

One of the sites is located at L. Tahoe, CA. Lake Tahoe is ideal for validating thermal infrared data for several reasons. The site is high (2km) minimizing the size of any atmospheric correction in comparisons to the radiance at sensor. The lake is large, allowing a wide range of pixel sizes to be validated and the lake is deep so does not freeze in the winter allowing validation year-round. In order to use L. Tahoe for validation, 4 buoys have been deployed. Each buoy includes a custom-built highly

accurate (50mK) radiometer measuring the surface skin temperature and several bulk temperature probes that trail behind the buoy. Each buoy includes a logging system with dial-up cellular access. One of the buoys also includes a full meteorological station measuring wind speed, wind direction, relative humidity and net radiation. All the measurements are made every 2 minutes on a continuous basis and downloaded daily via the cellular connection. The buoy measurements are supplemented with a variety of atmospheric measurements made on-shore. The site is currently being used for validation of data from a variety of airborne and spacborne sensors. Results from the validation of the thermal infrared data from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and the Moderate Resolution Imaging Spectroradiometer (MODIS) will be presented.

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